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When Second Opinions Hurt: A Model of Expert Advice under Career Concerns*

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Abstract

We augment the standard career concerns model by introducing (i) an action that blocks the information about the true state of the world and (ii) a second opinion/interim news after the initial consultation with the expert. In this model, the principal's action as well as the expert's message endogenously determine the observability of the states and consequently, the assessment of the expert's ability by the principal. We show that having access to better interim news could reduce the welfare of the principal due to its strategic effect on the expert's recommendation. We also discuss the implication of the results for possible delegation of decision making to another person with different decision parameters.

Keywords: Career Concerns, Reputational Cheaptalk, Signaling Game

JEL-Classification: D82, D83

1 Introduction

People seek advice from experts because one is likely to make a better choice with the aid of professional knowledge. Economists, however, have argued that it might not be in the expert's interest to tell the truth if he does not share

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the same preference with his client. In their seminal paper on cheap talk Crawford and Sobel (1982) assume that, conditional on the state, an informed advisor/expert's preferred action is different from that of the principal. So experts send biased recommendations to influence the principal's action in favour of their own preferences. Alternatively, the expert may have no interest in the principal's actions, but care about his own reputation of being smart or competent which is rewarded by markets. Efforts to appear smart might create incentive for experts to distort their recommendation. A growing literature focuses on the effects of this sort of 'career concern'.¹

Our paper is about the effect of a second opinion or an interim news in a model of career concern. Given that some experts might be not well informed and make wrong recommendations, the need for a second opinion arises quite naturally in this context. We will use a stylised story to motivate the model but its application is not confined to this particular setting. A government/principal (hereafter 'she') wants to undertake a reform/action and consults an expert (hereafter 'he') who has some information on the underlying state. The expert may have better information (the H type) or be less well informed (the L type) and only the expert knows his own type. Upon getting the expert's advice, the government decides whether to initiate the reform or maintain *status quo*. The *status quo* would produce a state-independent return so that the government cannot determine the expert's quality by observing the return. The return of the reform, however, depends on the underlying state. Hence, by observing the return of the reform the government will have a better idea of the expert's competence. Some research works have investigated similar scenarios and found that less well informed experts would want to hide their ignorance by recommending the *status quo*.²

We will analyze a similar principal- expert game with career concern where a second opinion/interim news is available to the principal. If by reversing a wrong reform the principal can recover some cost, then she would indeed care for a second opinion if it is sufficiently precise. Suppose the principal gets an interim news that contradicts the expert's pro-reform recommendation and she reverts back to *status quo*. But once the *status quo* is re-instated, she will

¹This is not the only way career concerns has been modeled. Often a smart agent is modeled as being more productive. See Holmstrom (1999) and Zwiebel (1995) for example.

²See Fu and Li (2010), Suurmond et al (2004), Song and Thakor (2006). In these studies, the expert himself is also the decision maker. Unlike our model, however, this is not crucial for their purposes. Even if there was a separate decision maker, as long as she follows the expert's advice (i.e., in *informative* equilibria), the outcome would be similar to those where the expert makes the decision himself.

not know for sure what the true state is. Was the expert really wrong or is it the interim news/ second opinion that is off the mark? From the expert's perspective, the principal's ability to assess his quality changes with the presence of the second opinion. Therefore, one might expect the expert's equilibrium strategy to change. Somewhat surprisingly, our first finding is that the less well informed expert is more inclined to recommend the reform when he knows that the principal could reverse it if she got contradictory interim news.

The interaction between the principal and the expert endogenizes the observability of the state of the world. The principal's action affects how accurately she is able to judge the expert's quality, which in turn affects the expert's reporting strategy, and consequently, the principal's welfare. In the second part of our investigation, we explore when it is indeed beneficial for the principal to have access to interim news. To keep things simple and get sharp intuition, we assume that the interim news, though it may be of different qualities, is transmitted non-strategically. We show that the principal's welfare does not necessarily improve by using an interim source of information. In particular, it goes down if the mediocre expert's information is of low quality and the interim news is of intermediate precision (although it is still good enough so that the principal follows it). Further, marginal increases in the precision of the interim news will continue to have ambiguous effect on the principal's welfare.

The model generates another line of enquiry. It shows that the strategy of experts is based on their reading of what the principal would decide about the reform/action- both initially and also after getting the interim news. Therefore, the principal might be better off by pre-committing *not* to entertain any interim news, although *after* the expert's recommendation, such news could help her make better choices. Following this line of reasoning we explore the possibility of delegation when it is institutionally feasible. If it is possible to publicly delegate the decision-making rights to another player with a different preference profile, would it improve the principal's welfare?³

In the early literature on information games, eg. Sobel (1985), Bénabou and Laroque (1992) etc, 'good' experts were assumed to always tell the truth. By contrast, if experts behave strategically so that signals are endogenous, there could be an adverse effect on the principal's payoffs. This issue has been explored in a variety of model structures starting from the early 1980s, eg. Hölmstrom and Ricart i Costa (1986), Sobel (1985), Scharfstein and Stein (1990), Hölmstrom (1999) etc. Endogenous signalling arises from two sources.

³Sengupta and Sanyal (2008) has explored the possibility of this kind of delegation in the context of a different model.

In works like Crawford and Sobel (1982) or Morris (2001) it appears from the preference of the agent (expert) for a particular action or outcome. In our model endogenous signals arise because the expert is judged by the signal and the judgment influences the agent's future earnings. (For example, see Ottaviani and Sorensen (2006).)

A number of contributions have appeared in the last two decades using signaling games in the career concern literature. They have produced variegated insights depending on the model structure and assumptions. Zwiebel's (1995) paper models agents/experts with varying productivity rather than varying signal precision. He finds that agents with very high and very low ability pick up unconventional tasks while agents of intermediate ability stick to the conventional ones. Levy (2004) finds that in order to signal their type, better informed agents tend to contradict the commonly held prior belief excessively. Suurmond *et al* (2004) show that an agent's reputational concerns might increase social welfare if it induces him to exert more effort in gathering information. Fu and Li (2010) investigates a model where low quality politicians might initiate detrimental reforms and studies optimal institution design to curb such initiatives.

To the best of our knowledge, in the literature on career concern models where the expert's reputation is determined by the accuracy of his information, ours is the first signaling game where the interaction between the principal and the expert is crucial due to the unobservability of the states when the *status quo* is chosen. In related papers such as Suurmond *et al* (2004) and Fu and Li (2010), such interaction is absent since the expert himself is the decision maker. Our model shares a common feature with Majumdar and Mukand (2004) in that there is the possibility of reversing the reform. They show that the expert tends to stick to the reform even if he gets a bad interim news. In their model, however, again the expert himself is the decision maker and thus their results and focus are quite different from ours. Two other models on reputation concerns should be mentioned where sequential reporting is involved.⁴ Ottaviani and Sorensen (2001) asks in a situation of sequential debates, whether it is better to let the smarter agent speak first. Li (2007) studies a model where the expert gets two signals over the time and reports them to the principal as they arrive. In both papers, the first message is always transmitted honestly as following his own signal is the best bet the expert can take. Thus the focus is on how later messages are distorted. Our model studies exactly the opposite problem.

⁴Models with sequential messages by multiple experts have been extensively studied in the more conventional cheap talk literature in line with Crawford and Sobel (1982). See, for example Krishna and Morgan (2001) and Battaglini (2003).

We assume that the second message is truthfully transmitted, but the way the principal reacts to it will affect the expert's incentive in truthfully transmitting the first message.

The rest of the paper is organized as follows. We introduce the main model environment, assumptions and present some preliminary results in Section 2. In the same section, we also develop a model where, unlike in our central model, the state of the world is always observable. This model is used as a benchmark against which the intuition of the central model is presented. Section 3 analyses the central model where the *status quo* choice does not reveal the true state. We characterise the expert's reporting strategy in the informative equilibria (formal definition in section 2) and develop their parameter restrictions. In Section 4 we investigate the welfare implication of the interim news for the principal. The central question explored is when is the existence of interim news welfare-enhancing. The possibility of delegation of decision making rights arises as a sequel to this discussion. Section 5 investigates various robustness aspects of the main result. (Appendix C also contains a detailed study of the symmetric information version of the model.) Section 6 offers some concluding remarks. All proofs are placed in appendix A and B.

2 The Model

2.1 Timing

The government/principal has an opportunity to undertake a reform. In state $\omega = 1$, the reform will be successful and the principal gets a return of $Y = 1$. In state $\omega = 0$, the reform fails and the return is $Y = -c$ ($c > 0$). Alternatively, she can keep the *status quo*, in which the return is independent of the states and is normalized to 0. In the central model, we assume that the common prior $\pi = \frac{1}{2}$ so that each state is equally likely. We will show in section 5 that the assumption is not necessary for our main results, but it helps sharpen the intuition. At the time of deciding whether to initiate the reform, the principal may consult an expert, who receives a private signal $s \in \{0, 1\}$. The expert can have high quality information (i=H) or be less well informed (i=L). The smart expert gets perfect information about the state so that $Pr(s = \omega|H) = 1$. The low type expert's information is noisy, so that $1 > Pr(s = \omega|L) = p > \frac{1}{2}$. Only the expert knows his own type, but it is common knowledge that a proportion $r \in (0, 1)$ of experts are smart. The expert sends a message to the principal from $m \in \{0, 1\}$. Since the state space is binary, there is no loss of generality in making the message space binary, too. We formally denote by $t_{is} : \{0, 1\} \mapsto [0, 1]$ the i-type expert's

strategy, which is the probability that the i-type expert reports $m = 1$ when he gets s .

Upon receiving the expert's message, the principal decides whether to initiate the reform ($x_1 = 1$) or not ($x_1 = 0$). If the principal keeps up the *status quo* ($x_1 = 0$), then no more action or information is available and the game ends with the return $Y = 0$. If she starts the reform, she has to pay a non-refundable initiation cost $k \in (0, 1)$. It takes a while for the outcome of the reform to be fully realised. In the meantime, the principal will receive an interim news $n \in \{g, b\}$ about the prospect of the reform. (We will be more explicit about the interim news in a later section.) If the state is $\omega = 0$ (so that the reform will indeed fail), the interim news is always bad, so that $Pr(n = g | \omega = 0) = 0$. On the other hand, even if $\omega = 1$, the interim news will be good only with probability $\beta \in [0, 1]$. That is, $Pr(n = g | \omega = 1) = \beta$.⁵ After getting the interim news, the principal can choose to persist with the reform ($x_2 = 1$) or revert back to the *status quo* ($x_2 = 0$). If she persists with the reform her return depends on the actual state. If she reverts back to the *status quo*, then $Y = 0$. (Note that the initiation cost k is sunk.) We summarize the timing of the game here:

1. The experts sees his type i and signal s and sends a message m to the principal.
2. The principal decides whether to start the reform. If so ($x_1 = 1$), she pays the non-refundable initiation cost k . Otherwise ($x_1 = 0$) no more action or information is forthcoming.
3. If $x_1 = 1$, the principal receives an interim news of precision β , and decides whether to continue with the reform. ($x_2 = 1$ if continued, $x_2 = 0$ if cancelled.)
4. The output (depending on the state and the principal's actions) is realised. The players receive their payoff. (See the next subsection.)

2.2 Payoffs

We assume that the principal cares only about the profitability of the project. Hence her (expected) payoff is given by

$$W = Y - kR$$

⁵We assume this particular asymmetric structure for the interim news because the calculation is easier. The results do not change qualitatively even if one assumes that errors in the interim news are symmetric.

where $R = 1$ if and only if the principal chooses to initiate the reform after the expert's report ($x_1 = 1$). Otherwise $R = 0$.

The expert on the other hand cares about his reputation. We define the expert's reputation, \hat{r} , as the posterior probability that the principal thinks that he is of H type at the end of the game. This is a common measure of reputation in the career concern literature, where it is usually assumed that the agent's future wage is positively correlated with \hat{r} . We do not explicitly model any future periods, and for the sake of simplicity, assume that the expert's payoff is linear in his posterior reputation,⁶ so that for both types of expert,

$$U = \hat{r}$$

Of course, the posterior reputation \hat{r} is derived from all available information the principal has at the end of the game. In particular, it might include the message sent by the expert, the observed output (and hence the principal's knowledge on the state) and the interim news received (conditional on the reform being initiated at the beginning).

We may briefly comment on some of our modelling choices. We assume that the H-type expert gets a perfectly informative signal to simplify our calculation. The characterisation of informative equilibria (see below) remains qualitatively unchanged if the H-type expert also gets a noisy signal. For more details, please refer to Appendix B. We also assume that the expert cares only about his reputation, but including some small outcome concern in his payoff does not qualitatively change the main results. Section 5 contains a more detailed discussion on this. The assumption that only the expert knows his own type, however, is important to some of our results. This is common in the literature, because the model is essentially a signalling game when the expert alone knows his own type. (See, for example, Levy (2004) and Li (2007).). We will investigate what happens when there is symmetric information in Appendix C.

2.3 Equilibrium selection

We look for (weak) PBE of the game. It is known that reputational cheap talk games can have a wide range of PBE; hence some selection criteria need to be imposed. First, we will restrict attention to equilibria that are "informative". That is, we rule out babbling equilibria where, for example, all experts send messages randomly regardless of their signal. This obviously is an equilibrium as

⁶It can be easily checked that our qualitative results will go through if the expert is risk averse. Our result is also robust if the expert is not "too risk-loving". See Li (2007), Effinger and Polborn (2001) for models that explicitly derive the reputation payoff function.

all messages are taken to be meaningless, so the principal’s posterior assessment of the agent remains the same as the prior and no deviation is possible. An equilibrium is “informative” if it satisfies the following two conditions:

1. The principal’s belief on the state depends on the messages sent.
2. There is a positive probability that at the end of the game, $\hat{r} \neq r$.

To understand the importance of the second condition, note that there exists an equilibrium where the first condition is met, but the principal will never change her posterior assessment of the agents. To see the intuition, let the L-type expert always truthfully report his signal. But let the H-type expert always report truthfully his signal with probability p . Clearly the condition 1 is met as the messages sent are still correlated with the true state. However, both experts are equally likely to make a wrong recommendation in equilibrium, thus the principal’s posterior assessment of the expert’s quality must always remain the same as the prior. Therefore no expert has an incentive to deviate. There are many reasonable justification one can use to rule out this type of equilibrium. For example, suppose the expert needs to pay an arbitrarily cost in order to obtain his information. However, given that in equilibrium, whether the prediction matches the true state or not does not affect the posterior reputation, then the expert would deviate and randomly make an announcement without paying to be informed.

It is commonly assumed in cheap talk games that the players know the exact “meaning” of the messages. Hence we will ignore mirror equilibria where one simply re-labels the messages. We also restrict attention to equilibria where the principal uses pure strategies. It is possible that in some equilibria, the principal might randomize over her initiation or cancellation choices. Including those equilibria does not bring much more insight but significantly complicates the discussion.⁷

2.4 Preliminaries

Before we start the formal analysis, it is useful to note the following result about informative equilibria. It can be shown that in any informative equilibrium, the H-type expert will always truthfully report his signal. Note that this result

⁷In those potential mixed strategy equilibria, the principal’s randomization choices must be credible *ex post*. This means that the intuition we gain in equilibria where she uses pure strategies will still go through. If the principal can pre-commit to some *ex post* inefficient actions (or randomization) at the beginning of the game, there will be interesting changes to our results. In fact, we probe into this kind of possibility when discussing delegation.

holds even if the H-type expert gets a noisy signal or if the principal randomises over some decisions. We present a proof of the lemma in a general setting incorporating these additional features in Appendix B.

Lemma 1 *In any informative equilibrium, the H-type expert must truthfully report his signals.*

After receiving the expert's message, the principal updates her belief on the state. We let α_m denote the principal's posterior assessment that $\omega = 1$ after getting message m . Following our definition of informative equilibria and the assumption that messages have their natural meanings, we must have $\alpha_1 > \frac{1}{2} > \alpha_0$ in equilibrium.

If the principal gets m , she will start the reform if and only if

$$\max\{\alpha_m - (1 - \alpha_m)c - k, \alpha_m\beta - k\} \geq 0 \quad (1)$$

The first expression on the LHS is the principal's expected payoff if she starts the reform after $m = 1$ and persists with it. The second expression is her expected payoff if she starts the reform after $m = 1$, but reverts back to the *status quo* after getting a bad interim news. Note that $\alpha_m - (1 - \alpha_m)c - k \geq \alpha_m\beta - k$ if and only if

$$\beta \geq 1 - \frac{(1 - \alpha_m)c}{\alpha_m}. \quad (2)$$

Of course, in equilibrium, α_m depends on the strategy of the expert. Thus, once the reform is initiated, the principal will revert back to the *status quo* after a bad news if and only if the news is sufficiently precise.

Before presenting our model, it will be useful to develop the standard case where the state always gets revealed regardless of the principal's actions. We will use this case as a benchmark to contrast our later results against it. It will clarify the role of *status quo*, which produces no knowledge about the state of the world in the signalling game. In this case, when assessing the quality of the expert, the principal would ignore the interim news and simply compare the expert's recommendation with the true state. We can show that Lemma 1 will still apply (see the proof in appendix B) and the H-type expert will always truthfully report his signal. Since the H type expert is more likely to get the correct signal, the principal's posterior assessment of the expert would be higher if it turns out to be correct. On the other hand, a wrong recommendation lowers the principal's opinion on the expert. (In fact, to $\hat{r} = 0$ given our assumption.) Now consider the L-type expert's incentive. If he reports his signals truthfully, his advice will match the true state with probability p . Since $p > \frac{1}{2}$, he indeed

prefers to report his signals truthfully. Note that the interim news has no effect on the expert's reporting strategy if the state is always revealed.

Hence, together with Lemma 1, the following proposition summarises the experts' equilibrium strategy. Note that this equilibrium is unique so far as the experts' strategies are concerned.

Proposition 1 *In the informative equilibrium, the L-type expert always truthfully reports his signals when the state is revealed regardless of the principal's action.*

3 The State is not Revealed in Status Quo

To keep the discussion tractable, we assume from now on that the initiation cost $k > \frac{1}{2}$ in the central model. Given the equal prior assumption, it implies that in any informative equilibrium, the principal will start the reform only if she gets $m = 1$. This means that there could be only two types of informative equilibria. In the first one, the principal starts the reform after $m = 1$ and continues with it regardless of the interim news (hereafter called CE for Continuation Equilibrium). In the other one, the principal starts the reform after $m = 1$, but reverts back to the *status quo* if and only if the interim news is bad (hereafter called DE for Discontinuation Equilibrium).⁸ This assumption is reasonable because it implies an environment where there is substantial cost at stake and the expert's advice is crucial to the principal's choice. In the discussion part later, we will briefly investigate the case where $k \leq \frac{1}{2}$.

3.1 Continuation Equilibrium (CE)

Since the return is independent of the states in the *status quo*, the principal will not know the true state if she ever chooses *status quo*. Hence, one would expect that the L-type expert will be more inclined to recommend the *status quo* in order to conceal his ignorance. We start with the simpler case of continuation equilibrium, where the precision of the interim news is low, so that once the reform is initiated, the principal will never revert back. For the time being, we

⁸One might wonder whether there are informative equilibria that satisfy the two criteria above, but the principal never chooses to initiate the reform. The answer is negative. Here is a sketch of the intuition: Suppose such an equilibrium indeed exists. Given the principal never starts the reform, her assessment of the expert after each message m , is unique. But this must imply that in equilibrium, both $m = 0$ or $m = 1$ induce the same assessment. Otherwise, the expert would deviate and report the m that induces a more favourable opinion. Now criterion 2 is violated.

bypass the existence problem and concentrate on the equilibrium strategy of the experts.

The H-type expert tells the truth by Lemma 1. But, we will show that the L-type expert cannot always report his signal truthfully in the CE. To see the intuition, suppose both types of experts truthfully report their signals. If $m = 0$, the principal will not start the reform and so will never get to know the true state. Given that the expert of either type would be telling the truth, the principal's posterior on expert type must remain unchanged following $m = 0$. Thus the low type expert's payoff from reporting $m = 0$ is $U_L = \hat{r} = r$. On the other hand, if the L-type expert truthfully reports his $s = 1$ signal, the principal will carry out the reform and a wrong recommendation will surely be found out. Intuitively, since he knows that he is of low type, the expert's expected posterior reputation will be lower than the prior. Therefore, he would strictly prefer deviating and report $m = 0$ instead. In fact, we can show that in the CE, the L-type expert always truthfully reports his $s = 0$ signal, but when he gets $s = 1$, he reports $m = 0$ with positive probability.

Given the experts' reporting strategy, the principal's belief on the state after $m = 1$ is

$$\alpha_1^{c*}(t_{L1}^{c*}) = \frac{r + (1-r)pt_{L1}^{c*}}{r + (1-r)t_{L1}^{c*}} \quad (3)$$

Of course, her belief after $m = 0$ must be $\alpha_0^{c*} < \frac{1}{2}$, as discussed in the preliminary part. Also note that it is necessary that in the informative equilibrium β is sufficiently low so that $\beta \leq 1 - \frac{(1-\alpha_1^{c*})c}{\alpha_1^{c*}}$. We summarize the result in the following proposition.

Proposition 2 *In a continuation equilibrium, the L-type expert truthfully reports $s = 0$ but mis-reports $s = 1$ with positive probability. That is, $t_{L1}^{c*} < 1$.*

3.2 Discontinuation Equilibrium (DE)

Suppose now that the interim news is sufficiently precise, so that the principal will cancel the reform if she gets a bad news. If the principal reverts back to the *status quo*, she will receive a return of 0 and will not be able to know the state for sure (unless $\beta = 1$). If the L-type expert truthfully reports his $s = 1$ signal, with probability $p\beta$ the principal knows that his suggestion is correct. With probability of $1 - p\beta$, the principal will get a bad interim news and cancel the reform. As in the continuation equilibrium, we can show that the L-type expert always tells the truth when $s = 0$ and misreports $s = 1$ with positive probability in the discontinuation equilibrium too.

An interesting question is whether or not the L-type expert will recommend the reform more often in the DE. We can show that $t_{L1}^{d*} \geq t_{L1}^{c*}$. So the answer is yes. Recall that the H type expert always tells the truth, but the L type expert misreports $s = 1$ with positive probability in equilibrium. Given equal prior, this means that, ex ante, the H type expert is more likely to send $m = 1$. Hence the L type expert has an incentive to mimic such action when $s = 1$. However, it is costly for him to do so because a wrong recommendation lowers his posterior reputation. In the CE, the principal can always be sure when a pro-reform recommendation is mistaken. But in the DE, if the principal cancels the reform, she will not know with certainty whether the expert was indeed wrong. Hence the L-type expert finds it more attractive to recommend the reform in the DE. In fact, conditional on the existence of the DE, when β is smaller, the principal is less sure about the true state after the cancellation, and consequently the incentive for the L-type expert to send $m = 1$ becomes higher. On the other hand, if $\beta = 1$, even if the principal cancels the reform, she would know for sure that the expert had fouled up. Hence $t_{L1}^{d*} = t_{L1}^{c*}$ if $\beta = 1$.

Given the expert's strategy, the principal's posterior belief on the state, following $m = 1$ is

$$\alpha_1^{d*}(t_{L1}^{d*}) = \frac{r + (1-r)pt_{L1}^{d*}}{r + (1-r)t_{L1}^{d*}} \quad (4)$$

Note that $\alpha_1^{d*} \leq \alpha_1^{c*}$ because $t_{L1}^{d*} \geq t_{L1}^{c*}$. Also it is necessary that in a discontinuation equilibrium, we have $\beta > 1 - \frac{(1-\alpha_1^{d*})c}{\alpha_1^{d*}}$.

Proposition 3 *In a discontinuation equilibrium,*

1. *the L-type expert truthfully reports $s = 0$ and misreports $s = 1$ with positive probability ($t_{L1}^{d*} < 1$);*
2. *the L-type expert reports $m = 1$ more often than in the CE. That is, $t_{L1}^{d*} \geq t_{L1}^{c*}$, with strict inequality holding if $\beta < 1$;*
3. *the L-type expert reports $m = 1$ more often if the interim news is less precise. That is, $\partial t_{L1}^{d*} / \partial \beta < 0$.*

3.3 Existence of Informative Equilibria

We now take up the question of the existence of informative equilibria (when the principal uses pure strategies). Recall that given our assumption $k > \frac{1}{2}$, the principal carries out the reform if and only if $m = 1$ in any informative equilibrium. We have noted that in both CE and DE, equilibrium strategies of the expert are uniquely determined. (For the detailed characterisation, please refer

to the proofs in the appendix.) It is necessary for the existence of informative equilibria that, given the experts' strategies, the principal indeed carries out the reform if $m = 1$. (See footnote 8 for a more detailed discussion.) Therefore, if an informative equilibrium exists, it is necessary that at least one of the two following inequalities is satisfied:

$$\alpha_1^{c*} - (1 - \alpha_1^{c*})c - k \geq 0 \Leftrightarrow \alpha_1^{c*} \geq \frac{c+k}{1+c}$$

$$\alpha_1^{d*} \beta - k \geq 0 \Leftrightarrow \alpha_1^{d*} \geq \frac{k}{\beta}$$

So, contrary to the benchmark case, the existence of informative equilibria is not guaranteed if the state is not revealed following some choice of action. Indeed, both α_1^{c*} and α_1^{d*} are bounded away from 1 for all $p > \frac{r}{2-r}$. (See proofs of the previous propositions. They also show that the experts' strategies and hence both α_1^{c*} and α_1^{d*} are independent of k .) If $k \rightarrow 1$, then no informative equilibrium is viable as the principal will never carry out the reform.

In addition, the existence of CE requires

$$\beta \leq \beta_1 = 1 - \frac{(1 - \alpha_1^{c*})c}{\alpha_1^{c*}} \quad (5)$$

while that of DE requires

$$\beta > \beta_0 = 1 - \frac{(1 - \alpha_1^{d*})c}{\alpha_1^{d*}} \quad (6)$$

Note that β_1 and β_0 depend on p and we have $\beta_1 \geq \beta_0$ as $\alpha_1^{c*} \geq \alpha_1^{d*}$. (Recall that when the state is not revealed after the choice of *status quo*, $t_{L1}^{d*} > t_{L1}^{c*}$ for all $\beta < 1$; in the benchmark case, $t_{L1}^{d*} = t_{L1}^{c*} = 1$).

In general, the existence of the informative equilibria in relation to the value of exogenous parameters such as β could be a messy issue. For example, it is possible that if β is low, a CE exists. When β increases so that $\beta > \beta_1$, by construction the CE is no longer viable. However, the DE might not exist either, because it is possible that $\alpha_1^{d*} < \frac{k}{\beta}$. Therefore, to simplify the discussions that follow we make two assumptions on the parameters for the rest of the paper:

Assumption 1 $r + (1 - r)p > \frac{c+k}{1+c}$.

Assumption 2 $p > \frac{r}{2-r}$.

Assumption 1 guarantees that an informative equilibrium always exists for all β . To see the intuition, note that the LHS is the lowest possible α_1^* in equilibrium when the L-type expert always tells the truth. On the other hand,

the RHS represents the highest threshold α_1^* needed by the principal to carry out the reform when no interim news is available.⁹ Assumption 2 guarantees that in the CE, the L-type expert reports $m = 1$ with positive probability. (See the proof for proposition 2 for detail.) We can now summarise the existence of informative equilibrium in the following proposition.

Proposition 4 *Let β_0 and β_1 be defined in (5) and (6). For all $\beta \in (0, \beta_0]$ there exists a unique CE; for $\beta \in (\beta_0, \beta_1)$ both the CE and the DE exist; and, for $\beta \in (\beta_1, 1)$, there exists a unique DE.*

One might wonder whether a similar conclusion can be drawn regarding p , the precision of the L-type expert's information. Does an increase in p make CE more likely? The answer is, not necessarily. In equilibrium, the principal's belief α_1^* is not monotonic in p . This is because an increase in p also causes the L type expert to be more confident and report $m = 1$ more often. (See proof of proposition 2 for details.) The direct effect of higher p and the strategic effect on the expert's message work in opposite directions. For example, when $p \rightarrow \frac{r}{2-r}$, the L type expert is very unlikely to report $m = 1$ and hence $\alpha_1^* \rightarrow 1$, but as p increases to some intermediate value, he reports $m = 1$ more often and $\alpha_1^* < 1$. Thus it is possible that the principal is *more* likely to cancel a reform when p is higher.

4 Interim News, Welfare and Delegation

We will explore two questions in this section. The first is (i) if the principal has a choice of accessing or not accessing the interim news, when is it beneficial to do so? The second question is (ii) can the principal improve her payoff by precommitting to a particular course of action? This query will lead to a related question about the possibility of delegation, i.e., entrusting the decision making to another player.

To appreciate the the first question, we should explain what we mean by 'the choice of accessing an interim news'. People seek a second opinion if in doubt about the initial advice they had received when starting off an action. In

⁹To see this formally, let $\alpha_L = r + (1-r)p$ and define $\beta_L = 1 - \frac{(1-\alpha_L)c}{\alpha_L}$. Clearly, a continuation equilibrium exists for all $\beta \leq \beta_1$. For all $\beta \geq \beta_0$, note that we have $\beta > \beta_L$. Since $\alpha_1^{d*} > \alpha_L$, a discontinuation equilibrium exists because

$$\begin{aligned} \alpha_1^{d*} \beta &> \alpha_L \beta_L \\ &= \alpha_L(1+c) - c > k \end{aligned}$$

case of governments, interim news can arise from parliamentary, bureaucratic or independent civic committees for monitoring reforms. Second opinions also arise from expert services, opinion polls, from the media and so on. There are many examples in the context of private decisions, too. For example, a patient often seeks a second doctor's or surgeon's opinion after starting on a course of medication recommended by his/her doctor. Business houses seek second opinion from law firms and accounting firms as they progress through a course of action recommended by inhouse experts. A government can publicly commit to use an interim news by setting up appropriate statutory institutions. In the opposite case it may set up procedures that do not look for or use a second opinion or interim news. The interim news or the second opinion will be assumed to be a non-strategic and truthful message, so that its precision β is exogenous.¹⁰

We will first address question (i). To proceed, we can imagine as if there was an extra "Stage 0" before the game started. At stage 0, the principal publicly makes an irreversible decision on whether to gain access to the interim news. (For example, the government decides whether to set up an independent monitoring committee that that would report to the government.) First assume that the principal chooses not to do so at Stage 0, so that $\beta = 0$. Given Assumption 1 of the previous section, we know that there is a unique CE where the expert's equilibrium strategy is given by t_L^{c*} . Given this strategy, the principal would have been better off with the interim news if and only if

$$\beta > \beta_1 = 1 - \frac{(1 - \alpha_1^{c*})c}{\alpha_1^{c*}} \quad (7)$$

However, if the principal had committed to use the interim news, that would also have changed the equilibrium strategy of the expert. We know from the last proposition that for all $\beta > \beta_1$, there is only one unique DE. Therefore, it is not immediately clear whether the principal is better off by setting up the interim news at Stage 0.

It will be clear from the following discussion that the question concerns with the change in the principal's payoff when use of the interim news causes a switch from a CE to a DE. Hence it leaves open the question as to whether a higher β will lead to a higher payoff in the discontinuation equilibrium itself. For concreteness, one can imagine that the existence of the interim news is exogenously given. For example, there is an independent media and the government is

¹⁰It would be interesting to assume that the source of the interim news also has reputation concerns just like the expert. In this case, the 'error' in the interim news might not be symmetric and needs to be endogenously derived. Unfortunately this comes at the cost of significantly complicating the model and we will stick to the 'exogenous error' version.

obliged to appear to be sensitive to media reports. Further, assume that $\beta > \beta_1$, so that the unique equilibrium is DE. Given this setting, we may investigate if it is always true that the principal will be strictly better off if there is a marginal increase in β .

4.1 If the state is always revealed

Recall that if the state is always revealed, both experts always tell the truth.

Let

$$q(t_{L1}^*) = r\frac{1}{2} + (1-r)\frac{1}{2}[pt_{L1}^* + (1-p)t_{L1}^*] = \frac{1}{2}(r + (1-r)t_{L1}^*) \quad (8)$$

denote the probability of the principal receiving $m = 1$. We write q as a function of t_{L1}^* only, because other signals are always truthfully reported (even when the state is not revealed). In this benchmark case, $t_{L1}^* = 1$ and $q = \frac{1}{2}$. When the principal does not have access to the interim news, her expected payoff is

$$W = W_c = q(t_{L1}^*)[\alpha_1^* - (1 - \alpha_1^*)c - k] \quad (9)$$

On the other hand, if she has access to interim news, her expected payoff becomes

$$W = \max\{W_c, W_d\}$$

where

$$W_d = q(t_{L1}^*)[\alpha_1^*\beta - k] \quad (10)$$

When the state is always revealed, answer to question (i) posed at the beginning of this section is straightforward. The experts' recommendations are independent of the interim news. The principal can ignore the interim news if it is not precise enough. On the other hand, when eq(7) is satisfied, the principal benefits by avoiding a possible failure by following the interim news. In other words, W_c is unaffected by β but W_d strictly increases with it. Thus the principal is never hurt by a more accurate interim news, and strictly benefits from it in the DE.

Proposition 5 *1. In the benchmark case, having access to the interim news never hurts the principal for all β and strictly benefits her when eq(7) is satisfied.*

2. A marginal increase in β never hurts the principal, and strictly improves her welfare if and only if eq(7) is satisfied.

4.2 The state is not observable in *status quo*

If the state is not observable with the choice of *status quo*, the result changes drastically because of the change in the expert's equilibrium strategy. We know from the previous result that $t_L^{d*} > t_L^{c*}$ so that the L type expert recommends the reform more often in the DE. From (9) and (10), we have

$$\frac{\partial W_c}{\partial t_{L1}^{c*}} \geq 0 \text{ if and only if } p \geq \frac{c+k}{1+c} \text{ and}$$

$$\frac{\partial W_d}{\partial t_{L1}^{d*}} \geq 0 \text{ if and only if } p \geq \frac{k}{\beta}$$

These results mean that in both types of equilibria, the principal prefers the L-type expert to truthfully report his $s = 1$ signal if and only if his precision p is sufficiently high. The following paragraphs explain the intuition.

In both types of equilibria, the principal starts the reform if and only if $m = 1$. But if the reform is suggested by the L-type expert, it is 'correct' only with probability p . Even the DE equilibrium is not costless for the principal who has to incur the initiation cost which becomes sunk. Hence, if p is too low, the principal would want the L-type expert not to recommend the reform at all. On the other hand, if p is suitably large, the principal's expected payoff is positive if she decides to reform following even the L-type expert's signal. In this case, the principal would like him to transmit his signals always truthfully.

Recall that, at a value of β just above β_1 , a CE is no longer possible. However, given the expert's CE strategy t_{L1}^{c*} , the principal is indifferent between cancelling the reform or continuing with it. Therefore, any change in her welfare must come from changes in the expert's strategy, i.e. from t_{L1}^{c*} to t_{L1}^{d*} . We have shown that the principal benefits from a higher t_{L1}^* in the DE if and only if $p\beta > k$. Therefore, when p is small the principal can be hurt if the precision of the interim news, too, is intermediate. By reversing this argument, when p is sufficiently large, the principal would prefer the L-type expert to recommend the reform more often. The following proposition formally states these observations.

- Proposition 6** 1. When $p \leq k$, there exists some $\epsilon_0 > 0$ such that, the principal's welfare is strictly lower when she has access to an interim news if and only if $\beta \in (\beta_1, \beta_1 + \epsilon_0)$.
2. When $p \geq \frac{c+k}{1+c}$, having access to the interim news will strictly improve the principal's welfare whenever $\beta > \beta_1$.

If the state is not observable in the *status quo*, the principal will surely be worse off if the L-type expert's quality is poor and the precision of interim

news too is not far above β_1 . On the other hand, if the expert's quality is sufficiently good, having access to any interim news above β_1 will strictly benefit the principal. But what happens to interim news with $\beta < \beta_1$? Clearly, for all $\beta < \beta_0$, having access to the interim news or not does not affect the principal's welfare as only a CE is possible. For $\beta \in (\beta_0, \beta_1)$, the answer is uncertain as multiple equilibria exist in this case. If the principal decides to use interim news at stage 0, but the players still "coordinate" on the CE, again there will be no effect on the principal's welfare. But suppose the players "coordinate" on the DE, then following the explanation in the preceding paragraphs, the principal is strictly worse off whenever $p < k$. If $p > \frac{c+k}{1+c}$, since the principal is better off at $\beta = \beta_1$, by continuity she is still better off when β is just below β_1 .

Remark 1 *Let $\beta \in (\beta_0, \beta_1)$, and the players coordinate on the DE if the principal gains access to the interim news.*

1. *If $p \leq k$, the principal is strictly worse off by gaining access to the interim news.*
2. *If $p \geq \frac{c+k}{1+c}$, there exists some $\epsilon_1 > 0$ such that for all $\beta \in (\beta_1 - \epsilon_1, \beta_1)$, the principal is strictly better off by gaining access to the interim news.*

Combining the above observations, we see that by committing to use interim news, the principal is strictly better off only if the quality of the interim news and the L type expert are sufficiently good. If the L type expert's information is very coarse and the interim news is of intermediate quality, the principal can be worse off using the interim news. (Note that the result in proposition 6 does not depend on the multiplicity of equilibria.)

The discussion provides an interesting observation. Suppose the principal chooses not to set up the interim news at stage 0. In that case, given the expert's strategy t_{L1}^{c*} , she will miss consulting an interim news after initiating the reform if $\beta > \beta_1$. However, had she set up the interim news at stage 0, she would actually be worse off when $p < k$ and β is not too far above β_1 . On the other hand, when $\beta < \beta_1$, given the expert's reporting strategy t_{L1}^{c*} , the interim news is useless to the principal. However, when $p > \frac{c+k}{1+c}$, the principal would be better off by setting up the interim news and "coordinate" with the expert on the DE, when β is not too far below β_1 . These peculiarities do not arise in the benchmark case. When the state is always revealed regardless of the actions, the principal is strictly better off to set up the interim news at stage 0 if and only if after the expert's report, she finds the news useful. When the state is not revealed following some action choice, the effects arise from the change of

experts' strategy when interim news is used. We will discuss more about this issue in the delegation part below.

We may wonder what happens to intermediate level $p \in (k, \frac{c+k}{1+c})$? Although the same intuition still carries through, the answer is less clear-cut. This is because whether the principal is better off when the “switch” between equilibria happens depends on whether $p\beta_1 > k$. (See the proof for proposition 6 for detail.) Recall that β_1 changes with p because the latter affects the principal's belief α_1^{c*} . We have noted at the end of the previous section that α_1^{c*} is not necessarily monotonic in p . Therefore, how the value of $p\beta_1$ changes with p is also uncertain. However, we can show that there exists some r^* ¹¹ such that for all $r < r^*$, α_1^{c*} and consequently $p\beta_1$ strictly increase with p . Thus, for $r < r^*$ we have the following more general result.

Corollary 1 *Assume $r < r^*$. There exists a unique $\hat{p} \in (k, \frac{c+k}{1+c})$ such that,*

1. *When $\beta > \beta_1$,*

for all $p < \hat{p}$, the principal will be strictly worse off by having access to some intermediate quality interim news just above β_1 . For all $p > \hat{p}$, the principal will be strictly better off by having access to all news with $\beta > \beta_1$.¹²

2. *When $\beta \in (\beta_0, \beta_1)$ and the players coordinate on the DE,*

for all $p < \hat{p}$, the principal will be strictly worse off by having access to the interim news. For all $p > \hat{p}$, there exists some ϵ'_1 such that for all $\beta \in (\beta_1 - \epsilon'_1, \beta_1)$, the principal will be strictly better off by having access to the interim news.

The next question is whether the principal benefits from a marginal increase in β . When β is close to β_1 , marginally increasing it might cause the equilibrium to switch from CE to DE and we have already discussed the welfare implication. Hence we focus on the marginal change in DE itself. We have

$$\frac{\partial W_d}{\partial \beta} = \frac{1}{2}[r + (1-r)pt_{L1}^{d*}] + \frac{1}{2}(1-r)(p\beta - k)\frac{\partial t_{L1}^{d*}}{\partial \beta} \quad (11)$$

¹¹ r^* is somewhere around 0.47. We can show that the necessary and sufficient condition for $\frac{\partial \alpha_1^{c*}}{\partial p} > 0$ is

$$r < \frac{2p}{(1-p)^2}[\sqrt{1+(1-p)^2} - 1]$$

The RHS is increasing in p for all $p \in (0.5, 1)$ and the minimum of the RHS when $p = 0.5$ is just over 0.47.

¹²We would like to note that in the first part of Proposition 6, the set of β above β_1 that makes the principal strictly worse off when $p \leq k$ is convex. This is not true in this case. This is because, when $p > k$, it is not necessarily true that W_d is monotonically increasing in β , which is discussed in detail in the following paragraph.

The sign of this expression is uncertain, because $\frac{\partial t_{L1}^{d*}}{\partial \beta} < 0$. On the one hand, increasing β means that a profitable reform is cancelled less often. However, the second part of the expression says that the L-type expert will be less likely to recommend a reform, which decreases the principal's payoff if $p\beta$ is sufficiently large. Note that if $p < k$, the second effect is always positive, since in this case, the principal always prefers the L-type expert not to send $m = 1$. We do not want to impose too many restrictions on the parameters (in particular, on those concerning $\frac{\partial t_{L1}^{d*}}{\partial \beta}$), but it is interesting to note that if p and β are already large, the principal might not wish β to improve further since it will adversely affect the incentive of the L-type expert.

4.3 Delegation

In this section, we take up question (ii) listed at the beginning of this section. We reason that the principal might be better off if she can pre-commit to a particular choice of action after receiving the interim news.

We have seen that if the state is not observable after *status quo* choice, the principal can be sometimes worse off with a better interim news. This occurs because she can not commit to carry out the reform to the end if there is a bad interim news. Her inability to continue with the reform makes it more attractive for the L-type expert to send the reform message, which is a signal of smartness in the model. We have seen that this can hurt the principal if p is small. On the other hand, when p is sufficiently large, the principal actually wants to encourage the L-type expert to recommend the reform. But if β is not large enough, the players could be stuck in a continuation equilibrium since, given the expert's reporting strategy t_{L1}^{c*} , the principal will not cancel the reform after a bad news. It appears that the principal could escape these constraints by precommitting to particular actions. One natural mechanism for this would be to delegate the decision rights to another decision maker who has a different cost of failure.

Imagine a government that is deciding about a potential reform. The government has an expert (or a department) to provide advice and another institution that will provide interim news of quality β if the reform is started. There is a (continuous) pool of potential decision makers who share the same benefit and initiation cost as the principal (the government), but differ in terms of their respective failure cost c_j , which is distributed over $[0, c_1]$. We assume that the principal's failure cost $c < c_1$ and retain Assumptions 1 and 2. We know from the last proposition that if $p < k$ and β is just above β_1 , switching to the discontinuation equilibrium will make the principal worse off. Note however that if her failure cost was less, she would have ignored the interim news. There-

fore, if institutional arrangements permit, she would be better off by delegating the decision rights to a person with $c_j < c$, thus committing to ignore the interim news. Conversely, suppose $p > \frac{c+k}{1+c}$ and β is just below β_1 . It is possible that both continuation and discontinuation equilibria can exist. Suppose for concreteness, that the players are stuck in the continuation equilibrium. The principal would be then better off by delegating the decision rights to some $c_j > c$ thus committing to cancel the reform if there is a bad news. Hence we obtain the following proposition:¹³

- Proposition 7** 1. *When $p \leq k$, whenever the interim news makes the principal worse off, she prefers delegating the decision rights to a person with $c_j = 0$*
2. *When $p \geq \frac{c+k}{1+c}$, there exists some $\eta_1 > 0$ such that for all $\beta \in (\beta_1 - \eta_1, \beta_1)$, if originally the players are in a continuation equilibrium, the principal prefers delegating the decision rights to a person with $c_j = c_1$.*

5 Discussion

5.1 When $k \leq \frac{1}{2}$

When $k \leq \frac{1}{2}$, there is an extra type of informative equilibrium. In this informative equilibrium, which we might name Initiation Equilibrium, the principal always starts the reform regardless of the message, but would revert back to the *status quo* if she gets $n = b$ and the message sent by the expert was $m = 0$. To save space, we will not fully characterize the existence conditions for this type of equilibrium, but explore the intuition behind the equilibrium strategy of the L-type expert, which we denote by $t_{L_s}^{I*}$. A detailed mathematical treatment is in the appendix. (H type expert still tells the truth. The proof for this is very similar to that for Lemma 1.)

As stated, the principal starts the reform in the initiation equilibrium irrespective of the message. Now imagine $\beta \rightarrow 1$. From the expert's perspective, the game is effectively the same as the benchmark case because the principal will inevitably get to know the true state (even if she cancels the reform later). Therefore, when β is very large, the L type expert must always tell the truth in

¹³If we also retains Assumption 3, then the following proposition will change just like in the previous subsection. Instead of $p < k$ and $p > \frac{c+k}{1+c}$, the results hold respectively for p smaller and greater than \hat{p} .

equilibrium. In fact, it can be shown that this is true for all

$$\beta \geq \frac{r(1-p)}{p[r + (1-r)(2p-1)]}$$

If the above inequality does not hold, the L type expert has an incentive to lie if $s = 1$. (But he will truthfully report his $s = 0$ signal.) Let t_{L1}^{I*} be the probability that he reports $m = 1$ when $s = 1$ in the initiation equilibrium. It can be shown that $t_{L1}^{I*} \geq t_{L1}^{c*}$, so that the L type expert would recommend the reform more often than in the CE. Because the principal will initiate the reform anyway, misreporting $s = 1$ is now less attractive as there is an increased probability of being caught compared to the CE. In addition, the principal has more knowledge about the true state when β is higher.

We now turn to the question of the principal's welfare when β becomes larger. Suppose at $\beta = 0$ and a CE exists. As before, let

$$q_1 = \frac{1}{2}[r + (1-r)t_{L1}^*]$$

$$q_0 = \frac{1}{2}[r + (1-r)(2 - t_{L1}^*)]$$

respectively denote the *ex ante* probability that the principal gets $m = 1$ and $m = 0$. Then, in the initiation equilibrium, the payoff of the principal is

$$W_I = q_1^I[\alpha_1^{I*} - (1 - \alpha_1^{I*})c - k] + q_0^I[\alpha_0^{I*}\beta - k]$$

Recall that her payoff in the CE is given by

$$W_c = q_1^c[\alpha_1^{c*} - (1 - \alpha_1^{c*})c - k]$$

Recall that $\frac{\partial W_c}{\partial t_{L1}^{c*}} < 0$ if $p < \frac{c+k}{1+c}$. Since $t_{L1}^{I*} > t_{L1}^{c*}$, a sufficient condition for the principal to be worse off with the interim news is $p < \frac{c+k}{1+c}$ and $\alpha_0^{I*}\beta - k \rightarrow 0$.

Here we give a numerical example of an initiation equilibrium using a small value of $k = 0.09$. Let $r = 0.1$, $c = 1.31$ and $p = 0.6$ and initially let $\beta = 0$. We can calculate that in the continuation equilibrium, $t_{L1}^{c*} = 0.9630$ and $\alpha_1^{c*} = 0.6414 > \frac{c+k}{1+c} = 0.6061$. The expected payoff of the principal is $W_c = 0.0395$. Now let $\beta = 0.25$. One can verify that in the initiation equilibrium, $t_{L1}^{I*} = 1$, $\alpha_1^{I*} = 0.64$ and $\alpha_0^{I*} = 0.36$. To check that the principal indeed cancels the reform only after $m = 0$, note that $1 - \frac{(1-\alpha_1^{I*})c}{\alpha_1^{I*}} = 0.26 > \beta > 0 > 1 - \frac{(1-\alpha_0^{I*})c}{\alpha_0^{I*}}$. To see that the principal will start the reform with either message, note that $\alpha_1^{I*} = 0.64 > \frac{c+k}{1+c}$ and $\alpha_0^{I*}\beta = 0.09 = k$. Finally, we can calculate that the expected payoff the principal is $W_I = 0.0392 < W_c$.

5.2 Unequal priors

Our assumption of equal prior means that the H-type expert is equally likely to get both signals. Therefore getting a particular signal is not an indication of smartness. Hence, the L-type expert has an incentive to recommend the *status quo* only because he is less likely to be exposed if it is chosen. With unequal prior, however, the H type expert is more likely to see one signal than the other; hence the L type expert's signalling incentive is more complicated. However, we can show that the L-type expert would continue to have incentive to 'hide' behind the message $m = 0$ as long as the prior is not too close to $\omega = 1$. We will only discuss the case of continuation equilibrium, as the intuition for the discontinuation equilibrium is very similar.

Let $\pi \in (0, 1)$ be the prior that $\omega = 1$. If $\pi < \frac{1}{2}$, an H-type expert is more likely to receive $s = 0$. Therefore, reporting $m = 0$ is a signal of being the H-type and this increases the incentive for the L-type expert to recommend the *status quo* even further. The opposite argument would indicate that if $\pi > \frac{1}{2}$, it will be less attractive for the L-type expert to misreport his $s = 1$ signal. But by continuity, if π is not too far above $\frac{1}{2}$, we still have $t_{L1}^* < 1$ in equilibrium.

To see the above arguments more formally, note that in a candidate truth-telling equilibrium, the posterior reputation for making the correct $m = 1$ recommendation and recommending $m = 0$ are, respectively,

$$\frac{r}{r + (1 - r)p} \text{ and } \frac{r}{r + (1 - r)[\frac{\pi}{1-\pi}(1 - p) + p]}$$

while an incorrect $m = 1$ recommendation results in $\hat{r} = 0$. The L-type expert will deviate and misreport the signal $s = 1$ if and only if

$$\frac{p\pi}{p\pi + (1 - p)(1 - \pi)} \frac{r}{r + (1 - r)p} < \frac{r}{r + (1 - r)[\frac{\pi}{1-\pi}(1 - p) + p]}$$

The above is equivalent to

$$\left(\frac{\pi}{1 - \pi} \right)^2 < 1 + \frac{r}{(1 - r)p}$$

The inequality holds for $\pi \leq \frac{1}{2}$. Therefore, the L-type expert will misreport $s = 1$ with positive probability as long as π is not too much larger than $\frac{1}{2}$.

5.3 Expert with outcome concern

Suppose the expert also cares about the profitability of the reform, W . In this case, his misreporting incentive will be mitigated, and the L type expert's reporting strategy t_{L1}^* in the informative equilibria will move closer to the principal's

preferred one. However, our qualitative results still remain unchanged as long as the expert does not put too much weight on the outcome.

We illustrate the effect of outcome concern using the CE. (The same argument goes through with the DE.) Recall that in the CE, the principal would like the L type expert always to truthfully report his signal if $p \geq \frac{c+k}{1+c}$. Otherwise, she would prefer that he never recommends a reform. For the L type expert, he also knows that following his $s = 1$ signal, the expected return of the reform is non-negative if and only if $p \geq \frac{c+k}{1+c}$. Thus, with outcome concerns, the L type expert has more incentive to report his $s = 1$ signal if and only if $p \geq \frac{c+k}{1+c}$. Therefore, compared to the main model where the expert cares only about his reputation, now in the CE, t_{L1}^* is larger (resp. smaller) if p is greater (resp. smaller) than $\frac{c+k}{1+c}$. This is exactly what the principal prefers.

6 Conclusion

This paper tries to understand two inter-related aspects of decision processes that use noisy information input from experts. The first is the role of those actions that block retrospective verification of the state of the world. These actions often come up as meaningful options in important public and private decisions. For example, not drilling at a site is an option that would block information on whether oil actually existed there; not raiding a hideout will make it impossible to know if the enemy uses it as shelter, and so on. If a principal is advised such an action and acts accordingly, then she cannot retrospectively verify the quality of the advice. This is an advantage for poor quality experts. A principal who does not know the quality of her advisors for sure, has to take this into account even as she uses their advice. This would leave its mark on the decisions taken, expected success of the decisions and the expected payoff of the principal.

The second issue, and that is the central concern of the paper, arises from this context quite naturally: is it possible to improve the decision by using a second opinion/ interim news? While common sense suggests that a second opinion cannot harm, we have shown that it is seriously misleading in this context. Even assuming that the source of the second opinion is non-strategic, it could hurt the principal if it is not sufficiently accurate.

How experts expect the principal to act after getting the second opinion has important effect on their advising strategy. When the principal is expected to cancel an action (that can potentially reveal the state) if the interim news is adverse, less well informed experts are encouraged to recommend that action

more often. So, having access to an interim news would in fact reduce the principal's welfare if those experts' information is sufficiently coarse and the second opinion not very accurate. Further, again contrary to common sense expectation, improvement in the quality of second opinion may not necessarily benefit the principal. Even when the principal retracts from the action after bad interim news (in the DE), the principal's payoff does not monotonically rise with the accuracy of the interim news. Those findings have important implications on practical policy making. For example, monitoring institutions that governments set up to provide interim feedback on policy initiatives may do more harm than merely wasting public resources, unless they house very accurate professional expertise.

Since much depends on what experts expect the principal to do after getting the interim news, we explored the possibilities if the principal could pre-commit to act in a particular way. In some contexts a natural way of pre-committing is to delegate the action choice to other persons who have different preference parameters. In the formal model we tried to capture it by the difference in the cost of failure. We have shown that the principal can improve expected payoff by delegating to others with higher or lower costs. We may provide an example here. A government sponsored project is being debated. The decision to go for it or not will be taken through a process like we outlined in our model: first an expert opinion and then, if it is started, an interim report on it. Suppose now that this project is a pet project of a particular minister who is known as its champion. If the project is taken up and fails, his personal cost would be large as it might cost him even his political career. His cabinet colleagues however would suffer smaller costs in case the project is wrongly chosen. The mechanism we examined would suggest a possible delegation of the decision making by the minister to some of his ministerial colleagues with lower cost of failure.

A Proofs

We first introduce some formal notations. Recall that the information available to the principal at the end of the game depends on her own choices and will be denoted by $I = \{m, \hat{\omega}, \hat{n}\}$. The principal always gets a report m from the expert. Her information about the true state of the world is denoted by $\hat{\omega} \in \{1, 0, \emptyset_{\omega}\}$. If the principal initiates the reform and sticks to it until the end, she will know the true state by observing the return. ($\omega = 1$ if and only if $Y = 1$.) If the reform is not initiated or canceled after the interim news, the principal always gets $Y = 0$ and she will not know the true state (hence

$\hat{\omega} = \emptyset_\omega$). The possible interim news the principal might receive is denoted by $\hat{n} \in \{g, b, \emptyset_n\}$. If the principal has chosen the *status quo* at the beginning ($x_1 = 0$), she is not going to receive any news so $\hat{n} = \emptyset_n$.

We let $U_{is}(m)$ denote the i-type agent's expected payoff from reporting m if he gets signal s .

A.1 Proof of Proposition 1

Proof. We first explicitly write the principal's posterior assessment of the expert.

$$\hat{r}(1, 1, \hat{n}) = \frac{r}{r + (1-r)[pt_{L1} + (1-p)t_{L0}]} \geq r \quad (\text{A1})$$

$$\hat{r}(0, 0, \emptyset_n) = \frac{r}{r + (1-r)[p(1-t_{L0}) + (1-p)(1-t_{L1})]} \geq r \quad (\text{A2})$$

$$\hat{r}(1, 0, \hat{n}) = \hat{r}(0, 1, \hat{n}) = 0$$

When $s = 1$

$$U_{L1}(1) = p\hat{r}(1, 1, \hat{n}) \text{ and } U_{L1}(0) = (1-p)\hat{r}(0, 0, \emptyset_n)$$

If $s = 0$,

$$U_{L0}(1) = (1-p)\hat{r}(1, 1, \hat{n}) \text{ and } U_{L0}(0) = p\hat{r}(0, 0, \emptyset_n)$$

To prove that the L-type strictly prefers to tell the truth, it suffices to show that $U_{L1}(1) > U_{L1}(0)$ and $U_{L0}(0) > U_{L0}(1)$. Suppose not and, for example, let $U_{L1}(1) \leq U_{L1}(0)$. Since $p > \frac{1}{2}$, we must then have $\hat{r}(1, 1, \hat{n}) < \hat{r}(0, 0, \emptyset_n)$. But then it must follow that $U_{L0}(0) > U_{L0}(1)$ and the L-type expert will strictly prefer reporting $m = 0$ when $s = 0$, i.e., $t_{L0} = 0$. Substituting into (A1) and (A2), we have

$$\hat{r}(1, 1, \hat{n}) = \frac{r}{r + (1-r)pt_{L1}} \geq \hat{r}(0, 0, \emptyset_n) = \frac{r}{r + (1-r)[p + (1-p)(1-t_{L1})]}$$

for all $t_{L1} \in [0, 1]$, which is a contradiction. A similar argument rules out the possibility that $U_{L0}(0) \leq U_{L0}(1)$. ■

A.2 Proof of Proposition 2

Proof. First note the principal's posterior assessments of the expert, given his strategies, are

$$\hat{r}(1, 0, b) = 0 \quad {}^{14} \quad (\text{A3})$$

¹⁴Strictly speaking, since we assume that the H type expert gets a perfect information, we need to consider the off the equilibrium path event when $t_{L1}^c = 0$, the principal receives $m = 1$ but the output $Y = -c$. We assume that in this case, the principal believes that the deviation comes from the L-type expert. This problem will not be present if we assume instead the H-type expert's signal is also noisy.

$$\hat{r}(1, 1, \hat{n}) = \frac{r}{r + (1-r)(pt_{L1}^c + (1-p)t_{L0}^c)} \quad (\text{A4})$$

$$\hat{r}(0, \oslash_\omega, \oslash_n) = \frac{r}{r + (1-r)(2 - t_{L1}^c - t_{L0}^c)}^{15} \quad (\text{A5})$$

We first establish that $t_{L0}^{c*} = 0$. Suppose $t_{L1}^{c*} > 0$. This means that if the L-type expert gets $s = 0$, his payoff from sending $m = 1$ is

$$U_{L0}(1) = (1-p)\hat{r}(1, 1, \hat{n}) \geq \hat{r}(0, \oslash_\omega, \oslash_n)$$

At $s = 1$, his expected payoff by sending $m = 1$ is

$$p\hat{r}(1, 1, \hat{n}) > (1-p)\hat{r}(1, 1, \hat{n}) \geq \hat{r}(0, \oslash_\omega, \oslash_n)$$

and thus $t_{L1}^{c*} = 1$. But then for all $t_{L1}^{c*} > 0$,

$$p\hat{r}(1, 1, \hat{n}) = \frac{pr}{r + (1-r)(p + (1-p)t_{L0}^{c*})}$$

which is less than

$$\hat{r}(0, \oslash_\omega, \oslash_n) = \frac{r}{r + (1-r)(1 - t_{L0}^{c*})}$$

and we have a contradiction.

Now suppose the L-type expert gets $s = 1$. Given $t_{L0}^{c*} = 0$, his expected payoffs from reporting $m = 1$ and $m = 0$ are, respectively,

$$U_{L1}(1) = p\hat{r}(1, 1, \hat{n}) + (1-p)\hat{r}(1, 0, b) = \frac{pr}{r + (1-r)pt_{L1}^c}$$

$$U_{L1}(0) = \hat{r}(0, \oslash_\omega, \oslash_n) = \frac{r}{r + (1-r)(2 - t_{L1}^c)}$$

When $t_{L1}^c = 1$, $U_{L1}(1) < U_{L1}(0)$ since $p < 1$. Therefore, a necessary condition for equilibrium is that he is just indifferent between sending either message.

That is, there needs to be a t_{L1}^{c*} such that

$$\frac{pr}{r + (1-r)pt_{L1}^{c*}} = \frac{r}{r + (1-r)(2 - t_{L1}^{c*})} \quad (\text{A6})$$

It is easy to verify that if $p > \frac{r}{2-r}$, there exists a unique $t_{L1}^{c*} = 1 - \frac{r(1-p)}{2p(1-r)}$ such that the above holds as equality. If $p \leq \frac{r}{2-r}$, the above can never hold for any $t_{L1}^{c*} > 0$.¹⁶ ■

¹⁵To understand the denominator, note that if the expert is L-type, in state 1, he sends $m = 0$ with probability $p(1 - t_{L1}^c) + (1-p)(1 - t_{L0}^c)$. In state 0, he sends $m = 0$ with probability $p(1 - t_{L0}^c) + (1-p)(1 - t_{L1}^c)$. The expression then follows from our assumption that each state is equally likely.

¹⁶The result that $t_{L1}^{c*} = 0$ for all $p \leq \frac{r}{2-r}$ is due to our assumption that the H type expert gets a perfect signal as well as the belief off the equilibrium path discussed in the

A.3 Proof of Proposition 3

Proof. First note that if the principal cancels the reform after a bad news, her assessment on the expert is

$$\hat{r}(1, \mathcal{O}_\omega, b) = \frac{r(1 - \beta)}{r(1 - \beta) + (1 - r)[(pt_{L1}^d + (1 - p)t_{L0}^d)(1 - \beta) + ((1 - p)t_{L1}^d + pt_{L0}^d)]} \quad (\text{A7})$$

We omit the proof for $t_{L0}^{d*} = 0$ and $t_{L1}^{d*} < 1$ as they are very similar to that in Proposition 3. As in proposition 3, the level of t_{L1}^{d*} is determined by equating the expert's expected payoff of reporting $m = 1$ and $m = 0$ when $s = 1$, which are, respectively,

$$\begin{aligned} U_{L1}(1) &= p\beta\hat{r}(1, 1, \hat{n}) + (1 - p\beta)\hat{r}(0, \mathcal{O}_\omega, b) \\ &= \frac{p\beta r}{r + (1 - r)pt_{L1}^{d*}} + \frac{(1 - p\beta)r}{r + (1 - r)[p + \frac{1-p}{1-\beta}]t_{L1}^{d*}} \\ U_{L1}(0) &= \frac{r}{r + (1 - r)(2 - t_{L1}^{d*})} \end{aligned}$$

It is easy to see that $\frac{\partial U_{L1}(1)}{\partial t_{L1}^{d*}} < 0$ and one can verify, after some algebra, that $\frac{\partial U_{L1}(1)}{\partial \beta} < 0$. Thus $\frac{\partial t_{L1}^{d*}}{\partial \beta} < 0$.

Note that when $\beta = 1$, $\hat{r}(0, \mathcal{O}_\omega, b) = \hat{r}(1, 0, b)$, so that $U_{L1}(1)$ is the same as that in the CE and we have $t_{L1}^{d*} = t_{L1}^{c*}$. It then follows that for all $\beta < 1$, $t_{L1}^{d*} > t_{L1}^{c*}$. ■

A.4 Proof of Proposition 6

Proof. Recall that without the interim news, the principal's expected payoff is given by

$$W_c = q(t_{L1}^{c*})[\alpha_1^{c*} - (1 - \alpha_1^{c*})c - k]$$

previous footnote. If we assume instead that the H type expert also has noisy information, with $p_L < p_H < 1$, in equilibrium we have $0 < t_{L1}^{c*} < 1$, $t_{L0}^{c*} = 0$ and the H type always reports truthfully. Therefore, our main result that the L-type expert misreports his $s = 1$ stays unchanged. The part that H-type reports truthfully even with noisy signals is proven in Appendix B. The proof for $t_{L0}^{c*} = 0$ is similar to the one above. To see that $0 < t_{L1}^{c*} < 1$, note that now

$$\begin{aligned} \hat{r}(1, 1, \hat{n}) &= \frac{rp_H}{rp_H + (1 - r)p_L t_{L1}^{c*}} \\ \hat{r}(1, 0, b) &= \frac{r(1 - p_H)}{r(1 - p_H) + (1 - r)(1 - p_L)t_{L1}^{c*}} \end{aligned}$$

and $\hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n)$ remains the same as before (due to equal prior). Now one can easily verify that there exists a unique $t_{L1}^{c*} \in (0, 1)$ so that $U_{L1}(1) = U_{L1}(0)$.

By construction, at $\beta = \beta_1$, the principal is just indifferent between cancelling the reform or not after a bad news, that is,

$$\begin{aligned} W_c &= q(t_{L1}^{c*})[\alpha_1^{c*} - (1 - \alpha_1^{c*})c - k] \\ &= q(t_{L1}^{c*})[\alpha_1^{c*}\beta_1 - k] = W_d(t_{L1}^{c*}) \end{aligned}$$

Let $\delta > 0$. When $\beta = \beta_1 + \delta$, the continuation equilibrium no longer exists. Taking $\delta \rightarrow 0$, The principal's expected payoff in the discontinuation equilibrium is

$$W_d|_{\beta_1} = q(t_{L1}^{d*})[\alpha_1^{d*}\beta_1 - k]$$

Part 1 It has already been established in the text that $\frac{\partial W_d}{\partial t_{L1}^{d*}} > 0$ if and only if $p\beta > k$. Since $t_{L1}^{d*} > t_{L1}^{c*}$, $W_d|_{\beta_1} \geq W_c$ if and only if $p\beta_1 \geq k$. If $p \leq k$, clearly, this is not possible as $\beta_1 < 1$. Therefore, for all $p \leq k$, $W_d|_{\beta_1} < W_c$. We have noted in eq(11) and the discussion that follows that W_d is monotonically increasing in β when $p \leq k$, therefore, it must follow that there exists some $\epsilon_0 > 0$ such that $W_d < W_c$ if and only if $\beta \in (\beta_1, \beta_1 + \epsilon_0)$.

Part 2 Suppose $p \geq \frac{c+k}{1+c}$. Since $\beta_1 = 1 - \frac{(1-\alpha_1^{c*})c}{\alpha_1^{c*}}$, and $\alpha_1^{c*} > \frac{c+k}{1+c}$ by assumption 1, it follows that $\beta_1 > \frac{k(1+c)}{k+c}$ and $p\beta_1 > k$. Hence, for all $\beta \geq \beta_1$, (Note that t_{L1}^{d*} , and consequently, α_1^{d*} depends on β)

$$\begin{aligned} W_d|_{\beta} &= q(t_{L1}^{d*}(\beta))[\alpha_1^{d*}(\beta)\beta - k] \\ &\geq q(t_{L1}^{d*}(\beta))[\alpha_1^{d*}(\beta)\beta_1 - k] \\ &> q(t_{L1}^{c*})[\alpha_1^{c*}\beta_1 - k] \\ &= W_c \end{aligned}$$

where the second last line follows because $t_{L1}^{d*} > t_{L1}^{c*}$ and $p\beta_1 > k$ (Thus the expression is increasing in t_{L1}^*). Thus the principal is always strictly better off by receiving the interim news with $\beta \geq \beta_1$. ■

A.5 Proof of Remark 1

Proof. Part 1 When $\beta < \beta_1$,

$$\begin{aligned} W_d(\beta) &= q(t_{L1}^{d*}(\beta))[\alpha_1^{d*}(\beta)\beta - k] \\ &\leq q(t_{L1}^{d*}(\beta))[\alpha_1^{d*}(\beta)\beta_1 - k] \\ &< q(t_{L1}^{c*})[\alpha_1^{c*}\beta_1 - k] = W_c \end{aligned}$$

where the inequality in the last line follows as $p\beta_1 < k$ and $t_{L1}^{c*} < t_{L1}^{d*}(\beta)$.

Part 2 Following part 2 of the previous proof, consider some $\epsilon_1 > 0$. Let $\epsilon_1 \rightarrow 0$, assumption 1 guarantees the existence of the discontinuation equilibrium

for $\beta \in (\beta_1 - \epsilon_1, \beta_1)$. In the DE, the principal's payoff is $W_d|_\beta$. When $p > \frac{c+k}{1+c}$, we have $W_d|_{\beta_1} > W_c$. By continuity, $W_d|_\beta > W_c$ for $\beta \in (\beta_1 - \epsilon_1, \beta_1)$ when ϵ_1 is sufficiently small. ■

A.6 Proof of Corollary 1

Proof. Following the proof of proposition 6, we know that when $p < k$, $p\beta_1 < k$ and when $p > \frac{c+k}{1+c}$, $p\beta_1 > k$. When $r < r^*$, we have $\frac{\partial \alpha_1^{c*}}{\partial p} > 0$ and thus $\frac{\partial \beta_1(p)}{\partial p} > 0$. Hence by continuity, there must exist a unique $\hat{p} \in (k, \frac{c+k}{1+c})$, such that $\hat{p}\beta_1(\hat{p}) = k$. The rest of the proof is almost identical to that in Proposition 6 and Remark 1 and omitted.¹⁷ ■

A.7 Proof of Proposition 7

Proof. The first part follows directly from proposition 6. Suppose principal is strictly worse off when the interim news is available. If the principal delegates the the decision rights to another person with $c_j = 0$, this person will surely ignore any interim news. Assumption 1 guarantees a continuation equilibrium exists and the principal's payoff is now $W_c > W_d|_\beta$.

When $p > \frac{c+k}{1+c}$, consider some $0 < \eta_1 < \epsilon_1$ as in remark 1. For all $\beta \in (\beta_1 - \eta_1, \beta_1)$, the principal's payoff in the DE is higher than W_c . If she delegates the decision rights to $c_j = c_1 > c$, by making $\eta_1 \rightarrow 0$, either $\alpha_1^{c*} < \frac{c_1+k}{1+c_1}$, or $\beta_1 - \eta_1 > 1 - \frac{(1-\alpha_1^{c*})c_1}{\alpha_1^{c*}}$, so that the CE is not possible. The existence of the discontinuation equilibrium is guaranteed by assumption 1. (The DE payoffs to both the new decision maker and the principal are independent of c as the failure cost is always avoided.) Following remark 1, for all $\beta \in (\beta_1 - \eta_1, \beta_1)$, the principal is strictly better off as $W_d|_\beta > W_c$. ■

A.8 Calculations for the case $k \leq \frac{1}{2}$

When the L type expert gets $s = 1$, his expected payoffs from reporting $m = 1$ or $m = 0$ are, respectively

$$U_{L1}(1) = p\hat{r}(1, 1, \hat{n}) \text{ and } U_{L1}(0) = (1 - p\beta)\hat{r}(0, \oslash_\omega, b)$$

When $s = 0$, the payoffs are

$$U_{L0}(1) = (1 - p)\hat{r}(1, 1, \hat{n}) \text{ and } U_{L0}(0) = (1 - (1 - p)\beta)\hat{r}(0, \oslash_\omega, b)$$

¹⁷The only difference is that the set of β above β_1 that makes the principal strictly worse off when $p < \hat{p}$ is not necessarily convex as W_d is not necessarily monotonically increasing in β in this case. See the discussion in the main text.

The standard argument shows that $t_{L0}^{I*} = 0$ so that he always truthfully reports his $s = 0$ signal. This implies that the principal's posterior belief on the expert is

$$\hat{r}(1, 1, \hat{n}) = \frac{r}{r + (1 - r)pt_{L1}^{I*}}$$

and

$$\hat{r}(0, \mathcal{O}_\omega, b) = \frac{r}{r + (1 - r)[(p(1 - t_{L1}^{I*}) + (1 - p))(1 - \beta) + ((1 - p)(1 - t_{L1}^{I*}) + p)]}$$

The L-type expert reports $m = 1$ with positive probability if and only if

$$p\hat{r}(1, 1, \hat{n}) \geq (1 - p\beta)\hat{r}(0, \mathcal{O}_\omega, b) \quad (\text{A8})$$

The LHS of the above equation is exactly the same as that in eq(A6), but the RHS is strictly smaller than that in eq(A6). Therefore, we know that $t_{L1}^{I*} > t_{L1}^{C*}$. In fact, by solving ineq(A8), one can find that $t_{L1}^{I*} = 1$ if and only if

$$(p + p\beta - 1)r \geq (1 - r)p\beta(1 - 2p)$$

.

B Proof of Lemma 1

In order to show that our characterisation of the informative equilibria is robust, we present the proof for more general settings. We consider the case where the H-type expert also gets noisy signals and allow for the possibility that the principal might randomise over both the initiation and cancellation choices. Let p_i denote the probability that the type i agent's signal correctly matches the true state, where $1 > p_H > p_L > \frac{1}{2}$. In addition, we maintain the assumption $k > \frac{1}{2}$. A similar, but tedious proof will go through when $k \leq \frac{1}{2}$. We present the proof to the case where the state is not revealed and focus on discontinuation equilibrium. The proof for other cases are very similar.

Proof. Step 1 We first show that in any informative equilibrium, the principal randomises with at most one signal at the initiation stage. In particular, under the assumption that $k > \frac{1}{2}$, she initiates the reform with positive probability only after $m = 1$.¹⁸ First, the principal's posterior belief of $\omega = 1$ is

$$\alpha_1 = \frac{r(p_H t_{H1} + (1 - p_H)t_{H0}) + (1 - r)(p_L t_{L1} + (1 - p_L)t_{L0})}{r(t_{H0} + t_{H1}) + (1 - r)(t_{L0} + t_{L1})}$$

¹⁸When $k < \frac{1}{2}$, she still randomises at at most one signal. But it is possible that she always start the reform with $m = 1$ and randomises at $m = 0$. But the method of proof in the following parts remains qualitatively similar.

$$\alpha_0 = \frac{r[p_H(1 - t_{H1}) + (1 - p_H)(1 - t_{H0})] + (1 - r)[p_L(1 - t_{L1}) + (1 - p_L)(1 - t_{L0})]}{r(2 - t_{H1} - t_{H0}) + (1 - r)(2 - t_{L0} - t_{L1})}$$

Suppose the principal initiates the reform with positive probability following both messages. We must have $\alpha_1 > \frac{1}{2}$ and $\alpha_0 > \frac{1}{2}$ because $k > \frac{1}{2}$. $\alpha_1 > \frac{1}{2}$ implies that

$$(2p_H - 1)r(t_{H1} - t_{H0}) + (2p_L - 1)(1 - r)(t_{L1} - t_{L0}) > 0$$

but $\alpha_0 > \frac{1}{2}$ implies that

$$(2p_H - 1)r(t_{H1} - t_{H0}) + (2p_L - 1)(1 - r)(t_{L1} - t_{L0}) < 0$$

Hence we arrive at a contradiction. Hence at least one of the $\alpha_m \leq \frac{1}{2}$ in the informative equilibrium and without loss of generality, we take this to be α_0 .

Thus, we let γ_1 be the probability that the principal initiates the reform after $m = 1$ and γ_2 be the probability that she continues with the reform after getting the bad news.

Step 2 We now prove that the H-type expert cannot randomise at both signals. Suppose he gets $s = 1$. By reporting $m = 1$, his expected payoff is

$$U_{H1}(1) = \gamma_1[p_H[(\beta + (1 - \beta)\gamma_2)\hat{r}(1, 1, \hat{n}) + (1 - \beta)(1 - \gamma_2)\hat{r}(1, \oslash_\omega, b)] + (1 - p_H)[\gamma_2\hat{r}(1, 0, b) + (1 - \gamma_2)\hat{r}(1, \oslash_\omega, b)]] + (1 - \gamma_1)\hat{r}(1, \oslash_\omega, \oslash_n)$$

When he gets $s = 0$ and by reporting $m = 1$, his expected payoff is

$$U_{H0}(1) = \gamma_1[(1 - p_H)[(\beta + (1 - \beta)\gamma_2)\hat{r}(1, 1, \hat{n}) + (1 - \beta)(1 - \gamma_2)\hat{r}(1, \oslash_\omega, b)] + p_H[\gamma_2\hat{r}(1, 0, b) + (1 - \gamma_2)\hat{r}(1, \oslash_\omega, b)]] + (1 - \gamma_1)\hat{r}(1, \oslash_\omega, \oslash_n)$$

In both cases, if he reports $m = 0$, he gets

$$U_{H1}(0) = U_{H0}(0) = \hat{r}(0, \oslash_\omega, \oslash_n)$$

Now if the H type expert does randomise at both signals, it implies that

$$U_{H1}(1) = U_{H0}(1) = \hat{r}(0, \oslash_\omega, \oslash_n)$$

Upon some algebraic manipulation, this is equivalent to

$$[\beta(1 - \gamma_2) + \gamma_2]\hat{r}(1, 1, \hat{n}) = \beta(1 - \gamma_2)\hat{r}(1, \oslash_\omega, b) + \gamma_2\hat{r}(1, 0, b) \quad (\text{B1})$$

By the second criterion of our informative equilibria, we cannot have $\hat{r}(1, 1, \hat{n}) = \hat{r}(1, 0, b)$. Otherwise we get¹⁹

$$\hat{r}(1, 1, \hat{n}) = \hat{r}(1, 0, b) = \hat{r}(0, \oslash_\omega, \oslash_n)$$

¹⁹To see this, we explicitly write out the full expression

$$\hat{r}(1, 1, \hat{n}) = \frac{r[p_H t_{H1} + (1 - p_H)t_{H0}]}{r[p_H t_{H1} + (1 - p_H)t_{H0}] + (1 - r)[p_L t_{L1} + (1 - p_L)t_{L0}]}$$

But together with $U_{H1}(1) = U_{H0}(1) = \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n)$ this would mean that

$$\hat{r}(1, 1, \hat{n}) = \hat{r}(1, 0, b) = \hat{r}(1, \mathcal{O}_\omega, b) = \hat{r}(1, \mathcal{O}_\omega, \mathcal{O}_n) = \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n)$$

which means that the principal's posterior on the expert will never change. Now suppose $\hat{r}(1, 1, \hat{n}) > \hat{r}(1, 0, b)$. But this implies that $\hat{r}(1, 1, \hat{n}) > \hat{r}(1, \mathcal{O}_\omega, b) > \hat{r}(1, 0, b)$ and eq(B1) cannot hold. A similar argument shows that we cannot have $\hat{r}(1, 1, \hat{n}) < \hat{r}(1, 0, b)$. Hence it is impossible for the H-type to randomise at both signals in an informative equilibrium.

Step 3 Finally, we rule out the possibility that the H-type expert randomises at just one signal. Suppose he randomises at $s = 1$ but truthfully reports at $s = 0$. This implies that

$$U_{H1}(1) = \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n) > U_{H0}(1)$$

which is equivalent to

$$\begin{aligned} & (\beta + (1 - \beta)\gamma_2)\hat{r}(1, 1, \hat{n}) + (1 - \beta)(1 - \gamma_2)\hat{r}(1, \mathcal{O}_\omega, b) \\ & > \gamma_2\hat{r}(1, 0, b) + (1 - \gamma_2)\hat{r}(1, \mathcal{O}_\omega, b) \end{aligned}$$

Note that the arguments in the previous part ensures that $U_{H1}(1) > U_{H0}(1)$, as strict equality would lead to eq(B1), which is shown to be impossible. Now consider the incentive for the L-type expert. When he gets $s = 1$

$$\begin{aligned} U_{L1}(1) &= \gamma_1[p_L[(\beta + (1 - \beta)\gamma_2)\hat{r}(1, 1, \hat{n}) + (1 - \beta)(1 - \gamma_2)\hat{r}(1, \mathcal{O}_\omega, b)] + \\ & \quad (1 - p_L)[\gamma_2\hat{r}(1, 0, b) + (1 - \gamma_2)\hat{r}(1, \mathcal{O}_\omega, b)]] + (1 - \gamma_1)\hat{r}(1, \mathcal{O}_\omega, \mathcal{O}_n) \\ &< U_{H1}(1) = \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n) \end{aligned}$$

since $p_L < p_H$. Hence the L-type expert strictly prefers reporting $m = 0$. When he gets $s = 0$, it is easy to check that

$$U_{L0}(1) < U_{L1}(1) < \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n)$$

since $p_L > \frac{1}{2}$. This means that the L-type expert will never report $m = 1$ and we must have

$$\hat{r}(1, 1, \hat{n}) = \hat{r}(1, 0, b) = \hat{r}(1, \mathcal{O}_\omega, b) = \hat{r}(1, \mathcal{O}_\omega, \mathcal{O}_n) = 1 = \hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n)$$

$$\begin{aligned} \hat{r}(1, 0, b) &= \frac{r[(1 - p_H)t_{H1} + p_H t_{H0}]}{r[(1 - p_H)t_{H1} + p_H t_{H0}] + (1 - r)[(1 - p_L)t_{L1} + p_L t_{L0}]} \\ \hat{r}(1, \mathcal{O}_\omega, b) &= \frac{r[(1 - p_H)t_{H1} + p_H t_{H0}] + (1 - \beta)r[p_H t_{H1} + (1 - p_H)t_{H0}]}{[r[(1 - p_H)t_{H1} + p_H t_{H0}] + (1 - r)[(1 - p_L)t_{L1} + p_L t_{L0}]] + \\ & \quad (1 - \beta)[r[(1 - p_H)t_{H1} + p_H t_{H0}] + (1 - r)[(1 - p_L)t_{L1} + p_L t_{L0}]]} \end{aligned}$$

Note that the denominator and numerator of $\hat{r}(1, \mathcal{O}_\omega, b)$ consist of, respectively, a weight sum of the denominator and numerator of $\hat{r}(1, 1, \hat{n})$ and $\hat{r}(1, 0, b)$.

which again is impossible.²⁰ A similar argument rules out the possibility that the H-type randomises at $s = 0$ only. This completes the proof. ■

C Symmetric information on the expert's type

When the expert does not know his type, the game is different because experts would not be involved in signalling. Instead, misreporting now arises from the experts' incentive to conform to that signal which is *ex ante* more likely. (See Prat(2005) for a related study.) To model this environment, denote the prior probability that the expert is H-type by r . Assume that an H-type expert always gets a perfect signal, but an L-type expert gets both signals with equal probability regardless of the state. The results discussed below do not change if they too get informative signals.

Neither the principal nor the expert know the latter's type. We let $\rho = r + (1 - r)\frac{1}{2}$ denote the *ex ante* probability that the expert gets the correct signal. In order to get some general results, we let the prior on $\omega = 1$ be $\pi \in (0, 1)$ and assume that $\rho > \max\{\pi, 1 - \pi\}$. This assumption means that the expert's signal is reasonably good so that by following it, the probability of being correct exceeds $\frac{1}{2}$. Without this assumption, it is even less likely that the expert will tell the truth.

To keep things simple, we maintain the assumption that $k > \frac{1}{2}$ so that the principal would not start the reform without the expert's advice for it. We also bypass the discussion of the existence of informative equilibria (existence conditions will be similar to those in the main model), but only investigate the expert's equilibrium strategy. Further, we focus on the discontinuation equilibrium, since the equilibrium strategy in the CE is the same as that in DE with $\beta = 1$.

This model environment has the following properties.

- Proposition 8** 1. When $\pi < \frac{1}{2}$, there does not exist any informative equilibrium.
2. When $\pi = \frac{1}{2}$, there exists an informative equilibrium where the expert always truthfully reports his signals.

²⁰In the main text, we assume that $p_H = 1$, which means that it is possible that in the continuation equilibrium $t_{L1}^{c*} = 0$. We assume that the off the equilibrium path belief $\hat{r}(1, 0, b) = 0$. However, it is easy to see that in the main text, in the continuation equilibrium the H-type expert cannot be randomising over $s = 1$ only. If he does so, it means $\hat{r}(1, 1, \hat{n}) = \hat{r}(0, \oslash_\omega, \oslash_n)$. For the low expert, $p\hat{r}(1, 1, \hat{n}) < \hat{r}(0, \oslash_\omega, \oslash_n)$ and he will never report $m = 1$. Now we have $\hat{r}(1, 1, \hat{n}) = 1 = \hat{r}(0, \oslash_\omega, \oslash_n) < 1$, which is not possible.

3. When $\pi > \frac{1}{2}$, there exists a discontinuation equilibrium where the expert always truthfully reports his signals only if β is sufficiently large. Otherwise, there cannot be a discontinuation equilibrium where the expert always truthfully reports his $s = 0$ signal. In the continuation equilibrium, the expert always tells the truth.

These results are somewhat striking. Especially, the first part of the proposition implies that if the prior on the state is biased towards $\omega = 0$ by just a little bit, the expert will never truthfully reveal his signal (even probabilistically), no matter how good his prior reputation is. To see the line of reasoning, note that if $\omega = 0$ is more likely, then an H-type expert is more likely to receive $s = 0$. Now suppose there is a truth-telling equilibrium. If the expert gets $s = 0$, his belief on himself being smart must go up, and so is the principal's after getting $m = 0$ (by assumption of truth telling). On the other hand, his belief on himself being smart must drop if he gets $s = 1$, which is *ex ante* less likely to be obtained by H-type experts. Because the information on the expert's type is symmetrical, the expert knows that if he sends $m = 1$ and the principal carries out the reform, his expected reputation must be less than r . Since the *status quo* choice would not reveal the true state, the expert will rather deviate and report $m = 0$ instead, because in the truth telling equilibrium, the principal's belief on him will be higher than r . (One might wonder whether the value of β will make a difference, or whether there could be a mixed strategy informative equilibrium. The proof of Proposition 8 will show that the answer is negative.) Therefore, when the information about experts' type is symmetric, any prior bias towards $\omega = 0$ will result in complete disappearance of informative equilibria. Of course, this very strong result depends on the assumption that the expert cares only about reputation. If he has some concern about the output, then truth telling is possible if p is sufficiently large. He may, for example, bet that $\omega = 1$ after $s = 1$ and hence recommend the reform if he cares sufficiently about the output.

The second part of the proposition says that when the prior on the state is just balanced, there always exists a truth telling equilibrium. This is quite expected following the intuition from the previous paragraph. Balanced prior means that both signals are equally likely to be received by the H-type. Therefore, the expert's belief in himself remains constant at r after receiving either message. Given symmetric information, this is also the rating he expects to get from the principal regardless of whether the reform is chosen or not. This means that he does not have an incentive to misreport.

When $\pi > \frac{1}{2}$, the signal $s = 0$ becomes the 'bad' signal. This means that

the expert is willing to report $s = 1$ truthfully but might want to misreport $m = 0$ in the discontinuation equilibrium. (In the continuation equilibrium this will not happen because the principal always gets to see the state after the reform is undertaken. So far as the expert's incentive is concerned, the continuation equilibrium is the same as the discontinuation equilibrium with $\beta = 1$.) However, when β is large, the principal is very certain about the state after a bad news and the expert would not want to lie when $s = 0$. Only when β is low, so that a bad news does not convey much information about the true state, does the incentive of misreporting becomes dominant.²¹

How is the principal's welfare affected as the interim news becomes more accurate? It is obvious that when $\pi < \frac{1}{2}$, there is no effect, because there can not be an informative equilibrium. When $\pi = \frac{1}{2}$, a higher β always benefits the principal as the expert always tells the truth. But when $\pi > \frac{1}{2}$, the principal's payoff can fall when β is higher. When $\beta = 0$, the expert will always tell the truth in the continuation equilibrium, conditional on its existence. Now suppose β increases to some intermediate value. It is possible from the above proposition that the expert misreports $s = 0$ with positive probability if the players enter the discontinuation equilibrium. If so, this must unambiguously lower the principal's welfare, because at $s = 0$, the principal's expected payoff from the reform is negative. (If an informative equilibrium does not exist, then the principal will never start a reform in a babbling equilibrium so that her payoff is zero, which is lower than that in the continuation equilibrium.)

C.1 Proof of proposition 8

Proof. We will prove only part (1) and part (3), the result in part 2 is straightforward after part (1). Since now the information on type is symmetric, we let t_s denote the probability the expert sends $m = 1$ after getting signal s . Also, note that we assumed that the messages have their natural "meaning". Thus we can assume without loss of generality that $t_1 > t_0$, as otherwise, one can simply re-label the messages. Given the expert's strategy, the principal's posterior belief on his type is

$$\hat{r}(1, 1, \hat{n}) = \frac{rt_1}{\rho t_1 + (1 - \rho)t_0}$$

$$\hat{r}(1, \phi_\omega, b) = \frac{r[\pi(1 - \beta)t_1 + (1 - \pi)t_0]}{[\rho\pi(1 - \beta) + (1 - \rho)(1 - \pi)]t_1 + [\rho(1 - \pi) + \pi(1 - \rho)(1 - \beta)]t_0}$$

²¹The question of existence of a mixed strategy informative equilibrium is quite messy. We do not pursue it here as it does not add too much extra qualitative insight.

$$\hat{r}(0, \mathcal{O}_\omega, \mathcal{O}_n) = \frac{r[\pi(1-t_1) + (1-\pi)(1-t_0)]}{[\pi\rho + (1-\pi)(1-\rho)](1-t_1) + [\pi(1-\rho) + \rho(1-\pi)](1-t_0)}$$

Part (1) $\pi < \frac{1}{2}$: First, using an argument very similar to that in the proof of proposition 2, we can establish that $t_0^* = 0$.²³ Now suppose the expert gets $s = 1$, by assumption of informative equilibrium, if he reports $m = 1$, the reform is carried out and his expected payoff is

$$\begin{aligned} U_1(1) &= \frac{r\pi\beta}{\pi\rho + (1-\pi)(1-\rho)} \\ &\quad + \left(1 - \frac{\pi\rho\beta}{\pi\rho + (1-\pi)(1-\rho)}\right) \frac{r\pi(1-\beta)}{\rho\pi(1-\beta) + (1-\rho)(1-\pi)} \\ &= \frac{r\pi}{\pi\rho + (1-\rho)(1-\pi)} \end{aligned}$$

On the other hand, his expected payoff from reporting $m = 0$ is

$$U_1(0) = \frac{r[\pi(1-t_1) + (1-\pi)]}{[\pi\rho + (1-\pi)(1-\rho)](1-t_1) + [\pi(1-\rho) + \rho(1-\pi)]}$$

Note that $U_1(0)$ is increasing in t_1 and $\min U_1(0) = \frac{r(1-\pi)}{\rho(1-\pi) + \pi(1-\rho)} > U_1(1)$. Thus it follows that the expert will not report $m = 1$ and there can be no informative equilibrium when $\pi < \frac{1}{2}$.²⁴

Part (3) $\pi > \frac{1}{2}$: Similar to the case of Part 1, one can establish that $t_1^* = 1$ in an informative equilibrium. Suppose the expert always tells the truth in the informative equilibrium, one needs to show that $t_0^* = 0$ and this means that

$$\begin{aligned} U_0(1) &= \frac{\pi(1-\rho)\beta}{\pi(1-\rho) + \rho(1-\pi)} \frac{r}{\rho} \\ &\quad + \left(1 - \frac{\pi(1-\rho)\beta}{\pi(1-\rho) + \rho(1-\pi)}\right) \frac{\pi\rho(1-\beta)}{\pi\rho(1-\beta) + (1-\rho)(1-\pi)} \frac{r}{\rho} \\ &\leq U_0(0) = \frac{r(1-\pi)}{\rho(1-\pi) + \pi(1-\rho)} \end{aligned}$$

One can verify that $U_0(1)$ is decreasing in β . At $\beta = 1$, $U_0(1) < U_0(0)$ and at $\beta = 0$, $U_0(1) > U_0(0)$. (Recall that $\rho > \max\{\pi, 1-\pi\}$.) Therefore there exists some $\tilde{\beta}$ at which $U_0(1) = U_0(0)$. It follows that for all $\beta > \tilde{\beta}$, in the DE, the expert always tells the truth. Otherwise, in the DE (if it exists at all), $t_0^* > 0$. The proof for the continuation equilibrium is straightforward. Simply note that in terms of the expert's reputation, the CE is equivalent to the DE with $\beta = 1$.

■

²²In the case of continuation equilibrium, one lets $\beta = 1$ and $\hat{r}(1, \mathcal{O}_\omega, b) = \hat{r}(1, 0, \hat{n})$

²³This proof is quite tedious, but relies on the fact that $t_1 > t_0$ implies that $\hat{r}(1, 1, \hat{n}) > \hat{r}(1, \mathcal{O}_\omega, b)$

²⁴The proof for Part (2) is simple: One can verify that if $\pi = \frac{1}{2}$, $U_1(1) = U_1(0)$ if $t_1 = 1$. Together with $t_0 = 0$, this establishes the existence of a truth telling equilibrium.

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